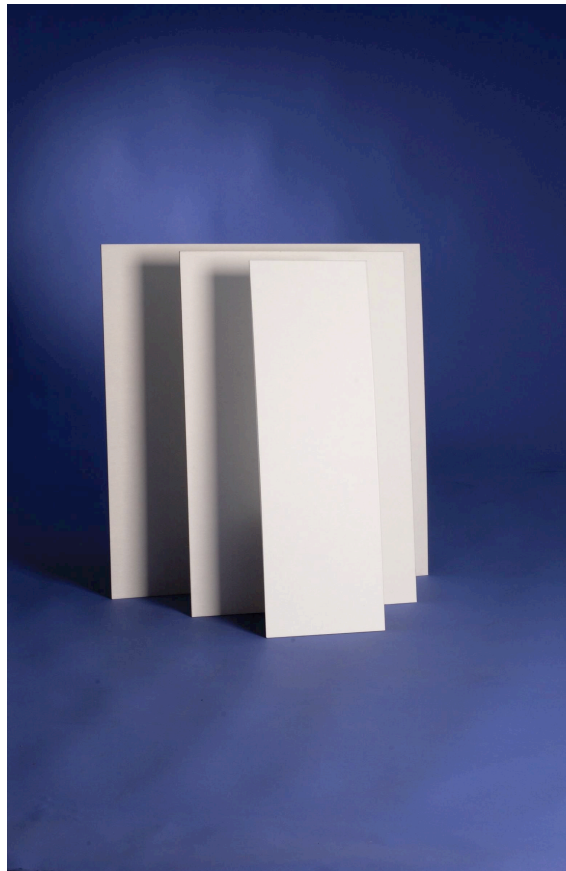




PANPHONICS
Audio Innovations



Audio Element Manual v1.0





Audio Element Manual v1.0

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1 Introduction

Panphonics Audio Element is a Finnish high quality technology product. It is manufactured with attention to detail to your satisfaction. The performance of each element is individually checked as a part of our manufacturing quality system. Panphonics Oy has protected the Audio Element technology with several international patents.

The purpose of the Panphonics Audio Element is to produce sound according to its technical specifications. Do not use it for other purposes. Signal and element characteristics should be chosen according to the needs of each application to ensure the best possible audio quality.

Adjustable product parameters as well as guidelines for special handling of the product are described in this document. Usage examples and ideas are given in the Designer's Guide document provided by the Panphonics Oy's technical support. Please consult the technical support in all questions regarding, for example, various applications of the element, integration of Panphonics technology to your product, unordinary usage situations, or harsh environmental conditions.

Current element version is 1.50. This manual is applicable to version numbers 1.50 and higher, until new version of the document is released.

Panphonics technical support: info@panphonics.fi or <http://www.panphonics.com>

2 Technical description

The Panphonics Audio Element is an electrostatic transducer. The way it is manufactured, however, places it to entirely different category compared to traditional electrostatic loudspeakers. In the element, a membrane vibrates between two surface layers, the so called stators, in coherence with the input audio signal. The whole input signal is fed to the entire element area, no frequency or spatial filtering is included.

The element has slim and light structure. It may require mechanical support or enclosure depending of the conditions in final application. Operation of the element is based on porous structure and its permeability to air. The element can be covered and its surface can be patterned applying various materials or techniques. In all cases, the air permeability requirement has to be met.

Do not unnecessarily bend or otherwise stress the element. Pressure can be applied on the element surface only at areas 5 millimetres or less from the edges. Do not cut, pierce or otherwise dismantle or mechanically damage the element structure without first asking for specific instructions from Panphonics technical support.

All the elements are of same thickness, 3.1 ± 0.3 mm. The elements are produced in three sizes, with tolerances ± 1 mm:

Model	Dimensions (mm)		Weight (g), without cable
	Width	Height	
S60	595	595	520
N40	396	595	350
N20	198	595	180

In addition to these sizes, it is possible to manufacture customer defined shapes and sizes fitting inside the area of a S60 element.



The elements have version numbering and serial numbers. These are technical in nature and help manufacturer to identify the individual attributes and quality control results of each product.

The maximum power handling capacity is frequency dependent. The table below shows the maximum signal voltage that can be applied to the element. Note that this voltage may damage the element. An adequate safety margin should be applied.

Frequency (Hz)	Max Driving Voltage (V, peak to peak)
100	500
1000	500
5000	500
10 000	500
20 000	300

The element is a capacitive load to the driving amplifier and operates with a special adapter or special amplifier only. It has no magnetic components and does not generate magnetic fields when in use. After operation, the bias voltage remains in the element for 30 seconds. When used without a short-circuiting system for unloading the bias, one should not remove connectors before that time for safety reasons. CE-approved audio elements have a safety area of 6 mm on the edge of the element. On this area there is no audio signal or electricity.

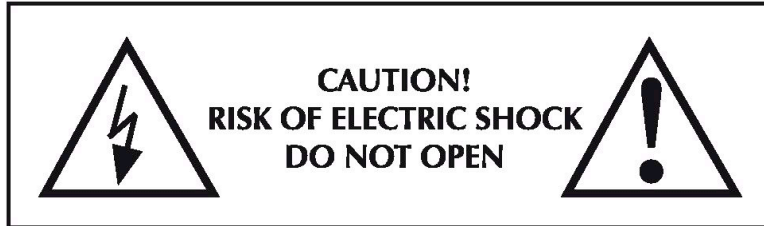
Element electronic connections and electrical ratings:

Black wire (pin 9)	AUDIO negative
Red wire (pin 6)	AUDIO positive, max. 500V p-p
White wire (pin 3)	BIAS VOLTAGE - 450V DC, max

Element capacitance is 40 nF (for S60, value depending of the element area). Impedance can be calculated with formula $Z=1 / (2 \pi f C)$, where f is frequency and C panel capacitance. The table below describes the amounts of current and power required to drive a 30 nF audio element at frequency dependent maximum voltages given above.

f (Hz)	I (A)	P (VA)
100	0.0044	0.8
1 000	0.0444	7.9
5 000	0.2221	39.3
10 000	0.4443	78.5
20 000	0.5331	56.5

The Panphonics product range includes amplifiers and passive adapters optimized to drive our audio elements. Information about manufactured electronics is found on amplifier and adapter operation manuals, available for downloading on our web pages, <http://www.panphonics.com/downloads>.



THE ELEMENT AND ATTACHED ELECTRONICS ARE HIGH VOLTAGE DEVICES. EVERY CAUTION MUST BE TAKEN AT ALL TIMES WHEN HANDLING THE SYSTEM. DO NOT TOUCH OR CONNECT ANY WIRING OR CONNECTORS WHEN POWER IS ON. ALWAYS DO ALL CONNECTIONS WHEN THE SYSTEM IS SHUT DOWN! DANGER OF HEALTH DAMAGE IF USED AGAINST THE INSTRUCTIONS!

The product codes used for customs clearing and international trade statistics:
HS-code: 851890 CN-code: 8518.90.00

3 Acoustic properties

The Panphonics Audio Elements are extremely directive. The directivity is a function of the frequency, as seen in Fig. 1. At frequencies above 2 kHz, the standard S60 size Panphonics audio elements have directivity of 4 degrees. Because of the directivity and the phase coherence of the produced wave field, the output sound pressure stays at equal level even to long distances.

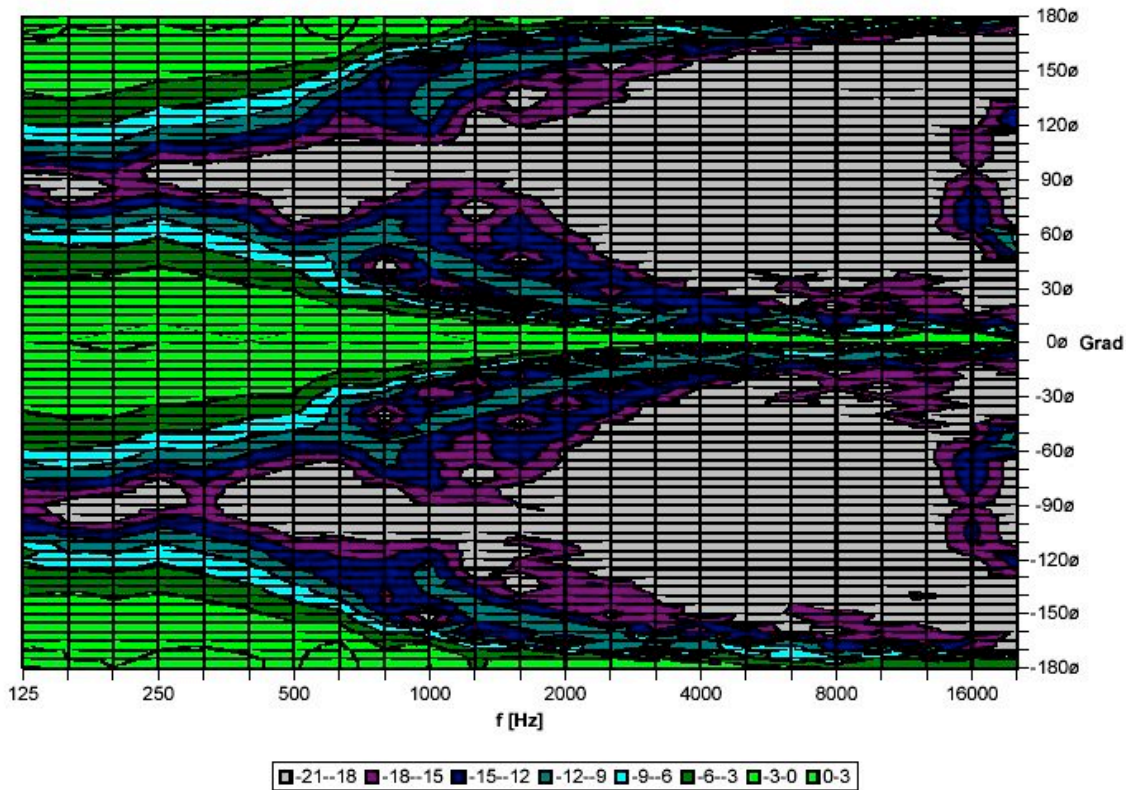


Figure 1: Directivity of a S60 audio element (measured for version 1.21). Sound pressure is plotted in dB relative to the on-axis level.



The directivity of the element can be controlled. The most convenient way to realize this is to bend the element slightly and evenly. Sometimes it is beneficial to maintain the flat structure of the element even in the final application with special directivity needs. In these cases, directivity control can be realised either with special surface treatment or with signal processing. In both cases, custom made elements are needed.

The element functions best at frequencies from 300 Hertz upwards. The nominal indented operational frequency range for the element is 300 – 22.000 Hz. The Panphonics audio elements have good quality of sound with very low harmonic distortion. The element has precise impulse response, enabling variety of applications and easy modifications to any specific use.

Maximum continuous sound pressure level is 95 dB, peak SPL being 108dB@8kHz / 3% THD, measured with element version 1.21.

Every doubling of the element surface area increases the produced audio energy with 3 dB. At the same time the frequency range is extended towards lower frequencies. With Panphonics technology, the increase in area increases also the directivity of the low frequencies. Because of optimised use of active area, installing elements side-by-side creates the same acoustical effect as having one element of the size and shape of the collage. As the audio output is created over the whole area of each element, no boundary effects such as high frequency comb filtering are detected.

4 Requirements for the amplifier

Like all electrostatic loudspeakers, Panphonics Audio Element appears as capacitive load to an amplifier, contrary to a conventional magnetic loudspeaker, the so-called dynamic loudspeaker, which is a resistive load. The element also requires bias voltage, which is not provided by typical audio amplifiers.

Resistive load dissipates power as heat. A capacitor stores electrical energy instead of converting it to heat. Capacitive load is highly reactive, which means that it sends the stored electrical power back to the amplifier when signal reverses polarity. This tends to cause problems to normal analogue amplifiers.

The power requirement of the Panphonics Audio Element can not be directly compared to that of a magnetic speaker. When driving an electrostatic loudspeaker, the amplifier has to handle a different relation between voltage and current than when driving a dynamic loudspeaker and the power requirement is highly frequency dependent. Therefore, one can not evaluate the ability of an amplifier to drive an electrostatic loudspeaker by its power rating. With a certain degree of simplification, an electrostatic element can be said to run on voltage instead of wattage.

Panphonics Oy produces a range of adapters designed for attaching the audio elements to typical low voltage amplifiers or to high voltage class-D amplifiers. Also, a range of amplifiers optimised for capacitive loads is available. More information on these products can be found from our web site, <http://www.panphonics.com>.



5 Environmental

The element as such is indented to indoor use, with operating temperature range from -10 to +70 degrees Celsius. Depending of other environmental conditions, such as humidity and mechanical stress, the range may be extended remarkably. In the operating environment the humidity combined with high temperatures should not rise above 70 % non-condensing. High heat and humidity may cause irreversible damages to the element. Same restrictions apply also to the storage environment of the element.

The element as such has ingress protection classification IP30. It has survived operational in very demanding environmental test sequence following the standard SAEJ-1885kJ. For more details, please contact Panphonics technical support.

6 Patents

The product is protected by one or more of the following patents or patent applications: US 6483924, US 6590985, US 09/308,442, US 6570818, CA 2,247,278, EP 0883972, JP 09-529838.

7 Terms of Warranty, Panphonics Audio Element G1 V1.5

Panphonics Oy warrants to the original purchaser that this Panphonics Oy's product (the "Product") will be free from defects in materials, design or workmanship, on the following terms and conditions:

Panphonics Audio Elements have been tested at the place of manufacture in accordance with the quality control of Panphonics Oy. Each notice of defects in the Product will be compared to the quality control record of the said Product. This Limited Warranty does not include deviations in audio performance characteristics of the Product if the performance characteristics entered into the quality control record have been correct and the purchaser cannot provide positive proof to the contrary, for example, inadequate transportation procedures.

- 1) The period of warranty will be six (6) months from the date the original purchaser took possession of the Product, or should have taken possession of the Product if the receipt of the Product was delayed due to a cause attributable to the purchaser. In case the original purchaser sells or otherwise assigns the Product to a new owner/user, the period of warranty will continue unaltered until the end of the original period of warranty.
- 2) This Limited Warranty is valid and enforceable only in the following states: European Community, Norway, Iceland and Switzerland.
- 3) During the period of warranty Panphonics Oy or its authorized maintenance service will either repair the defective Product or replace it with a new Product, at Panphonics Oy's option. Panphonics Oy will return the repaired Product or deliver a new Product to the purchaser in working order. All replaced parts and equipment will become the property of Panphonics Oy.
- 4) This Limited Warranty does include mechanical defects of the Product and significant deviations between technical data and performance characteristics of the Product.
- 5) The repaired or replaced Product will not be given extended or additional period of warranty.



6) This Limited Warranty does not include defects caused by normal tear and wear. In addition, this Limited Warranty will not be valid if:

i) The defect was due to

a. The use of the Product either contrary to instructions or otherwise negligently;

b. The Product being exposed to moisture, steam, extreme temperature or environment, or rapid changes in such, or corrosion or oxidation with corrosive materials, liquids or gasses or other way highly corrosive environment;

c. The Product being altered, connected to another product, opened or repaired without authorization or the Product being repaired with spare parts not approved by Panphonics Oy;

d. The Product being misused or installed incorrectly; or

e. The Product having been in on an accident or been exposed to the elements or spilled over with food or liquid, or been affected by chemical substances or other events beyond the scope of influence of Panphonics Oy, including but without limitation to labour dispute and every other event Panphonics Oy cannot reasonably be expected to overcome, for example fire or other natural catastrophe, war, rebellion, seizure, monetary exchange control, mandatory legislation, orders of authorities, refusal of export license, scarcity of transportation, general scarcity, restrictions in the use of power, and defects and delays of subcontractor's delivery caused by the above-mentioned causes unless the damage has been direct consequence of a defect in material or design or workmanship;

ii) The purchaser has not informed Panphonics Oy or its authorized maintenance service about the defect within thirty (30) days from the occurrence of the defect during the period of warranty;

iii) The Product has not been returned to Panphonics Oy or its authorized maintenance service within thirty (30) days from the occurrence of the defect during the period of warranty;

iv) The serial number of the Product has been transferred, removed or damaged, or any number has been altered or is impossible to read;

v) The defect was caused by the malfunction of an electronic appliance not provided by Panphonics Oy;

vi) The defect was caused as a consequence of the Product being used with an accessory, which was not manufactured, approved or provided by Panphonics Oy, or the Product was connected to such accessory, or the Product was used for other purposes than instructed, or the Product has been connected to such electronic system, which does not operate customarily compared to the normal use of the Product;

vii) The defect was caused as a consequence of an acoustic or electric overloading of the Audio Element.

7) In order to be able to invoke this Limited Warranty, the purchaser must provide either

i) Readable and unaltered original sales receipt/warranty card, which clearly sets out the name and address of the seller, the date and place of the purchase, the type of the Product and serial number, or alternatively

ii) Readable and unaltered original sales receipt, which brings out the same information if produced to the seller/supplier of the Product.

8) The purchaser's rights against Panphonics Oy based on defects or defective functions of the Product are limited to this Limited Warranty. This Limited Warranty will supersede all



other oral, written, statutory (unless mandatory), contractual and other warranties and liabilities. In no event will Panphonics Oy be liable for unforeseen, incidental, consequential or indirect damages or expenses. Should the purchaser be a company or other legal person, Panphonics Oy will not be liable for direct damages or expenses. Unless it is contrary to mandatory provisions of law, the purchaser will be finally responsible for product liability.

9) Any amendment or supplement to the terms of this Limited Warranty is binding on Panphonics Oy only if Panphonics Oy has beforehand accepted in writing to the amendment or supplement. The defective Product must be shipped to Panphonics Oy on the purchaser's expense.

8 EU Conformity

The product Panphonics Audio Element has been tested to be in conformity with the requirements of Low Voltage Directive (73/23/EEC), EMC Directive (89/336/EEC) or EN 60065 (1993) standard, as amended.

EC-DECLARATION OF CONFORMITY

We affirm that the electrical equipment manufactured by us fulfils the requirements of the Low Voltage Directive (LVD) 73/23/EEC, the Directive of Electromagnetic Compatibility (EMC) 89/336/EEC and the Amending Directive 93/68/EEC concerning these.

The construction of the appliance is in accordance with the following harmonised standards:

LVD

IEC 60065, 6th edition: 1998

Testing laboratory NEMKO Norway, order no 200306138 (2003-Feb)

EMC

Emission: Has not been performed because of the electrical characteristics of the Panphonics Audio Element and Adapter. The Panphonics Audio Element and Panphonics Audio Adapter do not contain components generating magnetic fields according to EN 55103-2 (1997)

Immunity: EN 55103-2 (1997)

NEMKO Product Services Oy, Finland, certificate no. 103 1589 (06.02.2003)




The appliance is CE-marked 2003.

Name of manufacturer	Panphonics Oy
Contact information of the manufacturer	Teollisuustie 13, FI-33330 Tampere, Finland tel. +358 32344 100, fax. +358 3 2344 130 e-mail: info@panphonics.fi
Description of the appliance	Loudspeaker element and adapter
Trade name, model and serial number of the appliance	Panphonics audio element G1 ver 1.12 and adapter ver 2.0. Serial number: as from 11001, every element and adapter has been registered in our database.
Name, address, telephone- and fax number of the manufacturer's authorised representative operating in the EEA-area	Panphonics Oy Olarinluoma 16, FI-02200 Espoo, Finland tel. +358 9 8193 8560, fax. +358 9 8193 8561, e-mail: info@panphonics.fi



9 Warnings and Disclaimers

The element must be connected to and controlled by devices fulfilling the technical specifications.

	<p>Electronically, the panel is a capacitor. Because of this, the panel may in certain circumstances have a residual electric charge. The residual charge must categorically be discharged from the panel before connecting/disconnecting it. This is best done with waiting for about 30 seconds before disconnecting the element wiring after shutting off the signal.</p>
	<p>THE ELEMENT AND ITS ELECTRONICS ARE HIGH VOLTAGE DEVICES. EVERY CAUTION MUST BE TAKEN AT ALL TIMES WHEN HANDLING THE SYSTEM. DO NOT TOUCH OR CONNECT ANY WIRING OR CONNECTORS WHEN POWER IS ON. ALWAYS DO ALL CONNECTIONS WHEN THE SYSTEM IS SHUT DOWN! DANGER OF HEALTH DAMAGE IF USED AGAINST THE INSTRUCTIONS!</p>
	<p>WARNING: THERE IS A RISK OF HEARING DAMAGE WITH THE USE OF THE PANEL. The audio characteristics of the panel differ from the common loudspeakers. The sound pressure level generated by the panel does not attenuate relative to distance, but is highly dependent of the direction. This will make it difficult for the user to realise the actual volume of the sound and may lead into unnecessary high SPL levels.</p>

PANPHONICS OY DISCLAIMS ALL ADDITIONAL OR FURTHER WARRANTIES AND REPRESENTATIONS, WHETHER EXPRESS, IMPLIED, STATUTORY OR OTHER WISE, INCLUDING BUT WITHOUT LIMITATION TO MERCHANTABILITY, FITNESS FOR PARTICULAR PURPOSES AND NON-INGRIMENT. Customer shall ensure that any enhanced products manufactured and sold by it and integrating the Products comply with all requirements and standards imposed by governmental regulations, and PP especially disclaims that the Products fulfil such requirements or standards, other than those set out in Council Directive 73/23/EEC (electrical equipment designed for use within certain voltage limits), Council Directive 89/336/EEC (electromagnetic compatibility) and Council Directive 93/68/EEC amending the aforesaid Council Directives. However, it is the intention of Panphonics Oy to take such requirements and standards into consideration with relation to the development of the Products. For this purpose, customer shall inform Panphonics Oy the requirements and standards in force other than those set out in the European Community, to the extent they apply to the Products.

All product information is subject to change without any prior notification. Panphonics Oy takes no liability of the accuracy or misinterpretations of the presented information.



10 Contact Information

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